Reg No: MSGC35/20202

Faculty of Health, Science and Technology
Mechanical Engineering

Syllabus

Finite Element Methods for Bachelors students

Course Code:	MSGC35
Course Title:	Finite Element Methods for Bachelors students *Finita elementmetoden för Högskoleingenjörer*
Credits:	7.5
Degree Level:	Undergraduate level
Progressive Specialisation:	First cycle, has less than 60 credits in first-cycle course/s as entry requirements (G1F)

Major Field of Study:
MTA (Mechanical Engineering)

Course Approval
The syllabus was approved by the Faculty of Health, Science and Technology 2020-03-12, and is valid from the Autumn semester 2020 at Karlstad University.

Prerequisites
30 ECTS credits in Mechanical Engineering (including Mechanics and Solid Mechanics) plus Mathematics, 15 ECTS credits, or registered in the Mechanical Engineering Bachelor programme, or equivalent

Learning Outcomes
The aim of the course is for students to acquire basic knowledge of the theoretical foundation of the Finite Element Method (FEM) and learn how to use commercially available software for FEM to solve different types of engineering problems.

Upon completion of the course, students should be able to:
- explain basic concepts such as node, element, degree of freedom, and stiffness matrix,

- give an account of the meaning of the virtual work principle,
- give an account of how the virtual work principle can be used combined with appropriate displacement approaches to derive element stiffness matrices for different types of mechanical element structures such as bars and disc elements,
- analyse structures of one and two dimensional bars and plane beams, using a commercial FEM program,
- use disc, plate, and shell elements to analyse strength engineering problems with the help of a commercial FEM program,
- give an account of the Newton-Raphson method for solving non-linear problem with one variable,
- use a commercial FEM program for linear instability analysis,
- calculate neutral frequencies with the help of a commercial FEM program,
- give an account of the concept convergence and how divergence studies are performed with FEM, and
- identify the cause of common types of problems in FEM analysis.

Content
Instruction is in the form of lectures and exercises with FEM software and focuses on:
- matrix statistics
- element stiffness matrices for different types of elements, primarily bars, beams, and plane elements
- assembly of stiffness matrix structures
-linear elastic analysis of elastic supporting bar structures, beam and shell constructions, and plane and asymmetrical structures
- linear stability and neutral frequency analysis

Reading List
See separate document.

Examination
Assessment is based on hand-in assignments and an individual written exam.

If students have a decision from Karlstad University entitling them to special pedagogical support due to a documented disability, the examiner has the right to give such students an adapted examination or to examine them in a different manner.

Grades
One of the grades Fail (U), 3 (Pass), 4 (Some Distinction), or 5 (Distinction) is awarded in the examination of the course.

Quality Assurance
Follow-up relating to learning conditions and goal-fulfilment takes place both during and upon completion of the course in order to ensure continuous improvement. Course evaluation is partly based on student views and experiences obtained in accordance with current regulations and partly on other data and documentation. Students will be informed of the result of the evaluation and of any measures to be taken.

Course Certificate
A course certificate will be provided upon request.

Additional information
The local regulations for studies at the Bachelor and Master levels at Karlstad University stipulate the obligations and rights of students and staff.